

ment of a butterfly emerging from the chrysalis, caterpillars feeding, the webs or tents woven and leaves curled up by caterpillars for their protection, and various insects in natural attitudes. We hardly think that "mourning-cloak butterfly" (under which name the life-history of this butterfly is ably dealt with) is any more happy than Camberwell Beauty. To read this dainty volume is to get a fair knowledge of the elements of entomology in a very pleasant way.

"The Brook Book," on lighter paper than the two volumes of this series just noticed, consists of a number of chapters describing the plants and live creatures to be met with in rambles along the banks (and in the bed) of brooks. Some of them relate the doings of a college walking party which explored their neighbourhood, and the occasional introduction of a professor or a "visiting geologist" leads to informing chapters, while the adventures of the members themselves add a vein of humour. It is impossible even to state the wide range of subjects so pleasantly dealt with, but they cover the settings and occupants of various kinds of brooks; and the enthusiasm of the writer and her pleasant way of introducing the subjects make the book just the thing to read aloud to elder children, and to instruct oneself with at the same time. The sixteen half-tone plates of brook scenery are very beautiful, and there are nearly seventy line engravings in the text.

We have in a volume of the American Sportsman's Library a capital guide to the waterfowl of North America, at once readable and scientific, and useful alike to the naturalist and the sportsman. Introductory chapters treating of the structure, character of the plumage, migrations, and the use as food and ornament of these groups, and of the necessity of affording them protection in spring, are followed by descriptions of the chief stations for wildfowling and of the various modes of shooting ducks and shore-birds. These chapters are written in the graphic language of an enthusiastic and thorough "workman." The details of actual shooting days and nights, with exciting and amusing incidents, written with a certain amount of expressive "western" words, will appeal strongly to all who have felt the glamour which hangs about "wildfowl." The body of the book is taken up with a scientific description of each species, giving details of the different stages of plumage at all ages and seasons, measurements, eggs, and habitat, followed by a general account of the habits. The waterfowl of the Pacific coast are separately dealt with, and the book closes with diagnoses of the families and genera. It is beautifully, though not profusely, illustrated, and the letterpress is printed on nice light paper, which makes this pleasing volume not too heavy to be held comfortably, despite its six hundred pages.

The object of Mr. Lange's handy volume is to point out to teachers some of the material which may be made the basis of profitable lessons in nature-study, and he has endeavoured to show how this material may be made available, and what the pupils may be taught about it. The plan here advocated is to take the children out into the fields and woods and to show them, and let them examine, various natural objects,

or to bring before them prepared and preserved objects and to instruct them in these. The teacher is told how best to do this. The book, indeed, consists of a series of lessons on various natural objects, in which the requisite information is given, and the teacher is told what material is necessary and how to obtain and use it. The author has been successful in producing a valuable manual of work for children whose school years close with the common school course. The numerous woodcuts are useful and to the purpose. Unfortunately for English readers the country for which the book is especially designed is the eastern States of North America. O. V. APLIN.

THE NATURE OF ELECTRICITY AND THE CONSTITUTION OF MATTER.

Conduction of Electricity through Gases. By J. J. Thomson, D.Sc., LL.D., Ph.D., F.R.S. Pp. vi + 566. (Cambridge: University Press, 1903.) Price 16s.

THIS book on the newest branch of physics, from the pen of its originator and chief exponent, deals with one of the most rapid and remarkable developments of modern scientific research. The "ionisation theory of gaseous conduction," it is claimed in the preface, not only gives a simple and direct explanation of the electrical properties of gases, but also affords the means of subjecting the fundamental problems of the nature of electricity and the constitution of matter to direct experimental attack. The reason is very clearly set forth.

"The possession of a charge by the ions increases so much the ease with which they can be traced and their properties studied that as the reader will see we know far more about the ion than about the uncharged molecule."

There is food for reflection for both the man of science and the philosopher in this comprehensive remark. Less than a decade ago the possibility of the existence of a gaseous ion was hardly recognised. Today this volume of very respectable dimensions testifies to the wealth of researches that have followed the inception of Prof. Thomson's theory. The researches of the author and his former pupils, Rutherford, Townsend, C. T. R. Wilson, Zeleny, Strutt, H. A. Wilson, Langevin and many others are brought together in this book and correlated with older researches and with those that have been proceeding simultaneously elsewhere.

In the two opening chapters the fundamental position is developed that the charge carried by the gaseous ion is the same for the ions of all gases, is independent of the ionising agency, and is equal to that carried by the hydrogen ion in electrolysis. This conclusion is arrived at from considerations of the diffusion velocity of the ions, and their velocity in an electric field, and needs only the assumption that the ions behave like the particles of a perfect gas towards pressure.

A second and completely independent determination of e for the same kind of ions is made possible by the application of the condensation experiments of C. T. R.

Wilson to the direct determination of the absolute number of ions present, and therefore of the individual charge carried by each ion. These are discussed in chapter vi., and lead to the same conclusion, that the charge is equal to that of the hydrogen ion in electrolysis. In chapter v. the ratio e/m of the charge to the mass is determined for the rapidly moving charged particles shot out by radium, by metals *in vacuo* under the influence of ultra-violet light, and by the kathode in the form of the kathode ray in the electric discharge through highly rarefied gases. A combination of the values of e found in chapters ii. and vii. with the ratio e/m found in chapter v. leads to the conclusion that m must be of the order of one-thousandth of the mass of the hydrogen atom.

On this is based the author's "corpuscular theory of electricity." The corpuscles—and it is to be noticed that the term *electron* is not used—are the discrete particles of negative electricity the presence or absence of which determines negative and positive electrification, and since the value e/m for the positive ion is never greater than for the hydrogen ion, it is concluded that a positive corpuscle does not exist, and the positive ion consists of the whole atom less one corpuscle.

The reader at this stage of the reasoning will probably question the propriety of thus combining the values found for e and e/m , for the two quantities have been determined for ions of completely different character. An earlier and more consecutive discussion of the dual character of the ion, according as to whether its charge or its energy is its chief experimental characteristic, and the adoption of some distinction in the nomenclature between the ions of the two classes, would no doubt have made the subject more clear. But it must be admitted also that this distinction, and the assumed identity of the charge for the two classes, is a point of weakness in the otherwise strictly consecutive train of reasoning. The critical stage of transition, where the ions of the first class change into the ions of the second—the slow diffusing negative ion in gases at high pressure, for example, acquiring under the action of an electric field, as the pressure of the gas is reduced, the energy and velocity of the kathode ray—seems to need further experimental study; for the conclusion that it is brought about by the ion shedding its attendant cluster of molecules and then travelling free seems mainly a consequence of regarding e as invariable. Although, no doubt, the arguments in favour of doing so are very strong, yet they appear somewhat indirect, and the anomaly that the slower moving ion is less effective as a nucleus for the condensation of moisture (p. 153) shows that the arguments are not all in its favour.

The view expressed in the chapter on ionisation by incandescent solids that the corpuscles exist in free motion inside metals and carbon, from which they escape when their kinetic energy is increased by rise of temperature, is, as the author points out, of great importance in its bearing on the variation of chemical affinity with temperature. Indeed, this book will be read by chemists with interest for the light it throws on the possible causes underlying phenomena often

considered simple merely on account of their familiarity.

The chapter on Becquerel rays is the longest in the book, and comprises a brief review of the most important work in radio-activity up to the commencement of the present year. Special prominence is given to the work of Rutherford, whose application of the ionisation theory to the problems of radio-activity has been so fruitful of discoveries. The applications of the theory to the spark discharge, the electric arc and the phenomena of the vacuum tube are treated very fully, and the last chapter includes a discussion of the important results of Kaufmann on the variation of e/m with v for the rapidly moving negatively charged particle from radium. The view is expressed that these results accord with the possibility that the whole of the mass of the corpuscle is electrical in origin.

The treatment, although exhaustive, is confined strictly to the subject-matter of the title, and the recent advances in spectroscopy of the inner constitution of the atom find no place. It is interesting to notice that Prof. Thomson frankly abandons all attempt to distinguish in nomenclature between the two forms of "radiation," the undulatory and the corpuscular, with which modern physics now has to deal. Both are designated "rays," and this extension of meaning, which is practically inevitable, is, of course, in strict accordance with the original Newtonian sense of the word.

F. S.

AN ENGLISH EDITION OF "ASTRONOMY FOR EVERYBODY."

Astronomy for Everybody. A Popular Exposition of the Wonders of the Heavens. By Prof. Simon Newcomb, LL.D., with an introduction by Sir Robert S. Ball, LL.D., F.R.S. Pp. xv+341. (London: Isbister and Co., Ltd., 1903.) Price 7s. 6d.

WHEN a popular exposition of the wonders of the heavens is written by such a man as the distinguished author of this volume, the reader, and more especially he who is greatly inclined to this science, naturally expects to find not only new ideas in the art of expressing difficult issues in simple language, but judgments on various doubtful points by one who is in the foremost rank of his work. The book before us is intended, as the title indicates, for the general reader, and should therefore be not only clear, concise, and accurate, but should be illustrated with the best diagrams and pictures of the period. The reader will therefore be very disappointed to know that this standard of excellence is by no means reached in these pages.

The general scope of the book is as follows:—First, the general ideas of the motions of the celestial bodies are dealt with, the reader being also briefly introduced to the chief kinds of instruments employed in investigating the motions and physical conditions of these bodies. The sun, moon, earth, planets and their satellites are next each described, then comets and meteors come in for their turn, while a general review of the fixed stars fills up the remaining portion of the book.